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Attorney Docket No. TOMK0002
Client Matter No. 20617.0002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	10/692,998	Confirmation No.	9351
Applicant:	Graham DAVIS	Title:	AMPHIBIOUS VEHICLE
Filed:	October 24, 2003		
TC/A.U.	3617		
Examiner:	Andrew D. WRIGHT		
Docket No.	TOMK0002		
Customer No.	25235		

CERTIFICATE OF MAILING BY EXPRESS MAIL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

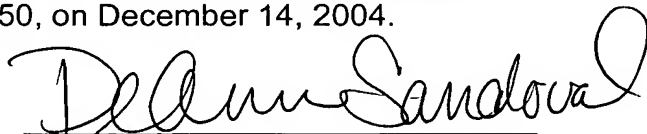
Sir:

The undersigned hereby certifies that the enclosed

1. Transmittal of Certified Copy of Priority PCT Application;
2. Certified Copy of PCT/GB02/01908;
3. Return Card, and

this Certificate of Mailing by Express Mail relating to the above application, were deposited as "Express Mail," Mailing Label No. EL533456675US with the U.S. Postal Service, addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on December 14, 2004.

December 14, 2004



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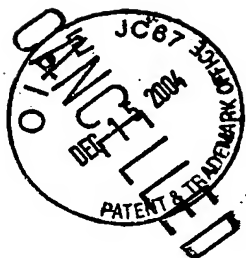
December 14, 2004



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TRANSMITTAL OF CERTIFIED COPY OF PRIORITY PCT APPLICATION

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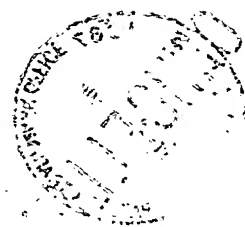
Sir:

Enclosed herewith is a certified copy of PCT/GB02/01908 from which priority is claimed. Please contact the undersigned by telephone with any questions regarding the enclosed.

Respectfully submitted,

December 14, 2004


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INVESTOR IN PEOPLE

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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the international application filed on 29 April 2002 under the Patent Cooperation Treaty at the UK Receiving Office. The application was allocated the number PCT/GB2002/01908.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or the inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, L.C. or PLC.

Registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Date: 29 November 2004

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PRIORITY DOCUMENT

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PCT**REQUEST**

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/GB 02 / 01908

International Application No.

29 APRIL 2002International Filing Date **29/04/2002**

United Kingdom Patent Office

PCT International Application

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum)

Box No. I TITLE OF INVENTION AMPHIBIOUS VEHICLE	
Box No. II APPLICANT <input type="checkbox"/> This person is also inventor	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
Sealander Marine International Ltd 106 Helston Road Penryn Cornwall TR10 8NG GB	
Telephone No.	
Facsimile No.	
Teleprinter No.	
Applicant's registration No. with the Office	
State (that is, country) of nationality: GB	State (that is, country) of residence: GB
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
DAVIES, Graham Higher Trevethan Redruth Cornwall TR16 5HJ GB	
This person is: <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)	
Applicant's registration No. with the Office	
State (that is, country) of nationality: GB	State (that is, country) of residence: GB
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<input type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: <input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
SHELLEY, Mark Raymond K R Bryer & CO 7 Gay Street Bath BA1 2PH GB	
Telephone No.	
Facsimile No.	
Teleprinter No.	
Agent's registration No. with the Office	
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

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PCT/GB 02/01908

Sheet No.

Box No. V DESIGNATION OF STATES

Mark the applicable check-boxes below: at least one must be marked.

The following designations are hereby made under Rule 4.9(a):

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH & LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line) *GA*

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | | |
|---|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates | <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> AG Antigua and Barbuda | <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> MZ Mozambique |
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> IN India | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> IS Iceland | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> JP Japan | |
| <input checked="" type="checkbox"/> BG Bulgaria | <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> KG Kyrgyzstan | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> BZ Belize | <input checked="" type="checkbox"/> KR Republic of Korea | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> KZ Kazakhstan | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> CH & LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> LC Saint Lucia | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> LK Sri Lanka | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> CO Colombia | <input checked="" type="checkbox"/> LR Liberia | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> CR Costa Rica | <input checked="" type="checkbox"/> LS Lesotho | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> LT Lithuania | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> LU Luxembourg | <input checked="" type="checkbox"/> TZ United Republic of Tanzania |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> LV Latvia | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> MA Morocco | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> DM Dominica | <input checked="" type="checkbox"/> MD Republic of Moldova | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> DZ Algeria | | |
| <input checked="" type="checkbox"/> EC Ecuador | <input checked="" type="checkbox"/> MG Madagascar | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> MN Mongolia | <input checked="" type="checkbox"/> YU Yugoslavia |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> MW Malawi | <input checked="" type="checkbox"/> ZA South Africa |
| <input checked="" type="checkbox"/> GB United Kingdom | | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> GD Grenada | | |
| <input checked="" type="checkbox"/> GE Georgia | | |

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

- ☒ GQ Equatorial Guinea ☐ TN Tunisia
- ☒ OM Oman ☐ PH Philippines

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

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Sheet No.

Box No. VIII (i) DECLARATION: IDENTITY OF THE INVENTOR

The declaration must conform to the standardized wording provided for in Section 211; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (i). If this Box is not used, this sheet should not be included in the request.

Declaration as to the identity of the inventor (Rules 4.17(i) and 51bis.1(a)(i)):

Declaration as to the identity of the inventor (Rules 4.17(I) and 51bis.1 (a) (i)):
In relation to this International Patent Application.

DAVIES, Graham of Higher Trevethan, Redruth, Cornwall TR16 5HJ, Great Britain, is the inventor of the subject matter for which protection is sought by way of this International Application. this declaration is made for te purposes of:

All designations

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (i)".

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PCT/GB 02 / 01908

Sheet No.

Box No. VIII (ii) DECLARATION: ENTITLEMENT TO APPLY FOR AND BE GRANTED A PATENT

The declaration must conform to the standardized wording provided for in Section 212; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (ii). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(ii) and 51bis.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate:

Declaration as to the applicant's entitlement, as at the International filing date, to apply for and be granted a patent (rule 4.17(ii) and 51bs.1 (a)(ii), in a case where the declaration under Rule 4.17(iv) is not appropriate:

In relation to this international Application Sealander Marine International Ltd is entitled to apply and be granted a patent by virtue of the following:

Sealander Marine International Ltd is entitled as employer of the inventor, DAVIES, Graham.

This declaration is made for the purpose of all designations except the United States of America.

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (ii)".

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Sheet No.

PCT/GB 02 / 01908

Box No. VI PRIORITY CLAIM				
The priority of the following earlier application(s) is hereby claimed:				
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 27.04.01 27 April 2001	0110347.2	GB		
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office) identified above as:

☐ all items ☒ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / EP

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year) Number Country (or regional Office)

Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) (mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):

		Number of declarations
<input checked="" type="checkbox"/> Box No. VIII (i)	Declaration as to the identity of the inventor	1
<input checked="" type="checkbox"/> Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	1
<input type="checkbox"/> Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	
<input type="checkbox"/> Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	
<input type="checkbox"/> Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	

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Sheet No.

PCT/GB 02 / 01908

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:

(a) the following number of sheets in paper form:

request (including declaration sheets) : 6

description (excluding sequence listing part) : 11

claims : 4

abstract : 1

drawings : 6

Sub-total number of sheets : 28 28

sequence listing part of description (actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)

Total number of sheets : 28 28

(b) sequence listing part of description filed in computer readable form

(i) ☐ only (under Section 801(a)(i))(ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained (additional copies to be indicated under item 9(ii), in right column):

This international application is accompanied by the following item(s) (mark the applicable check-boxes below and indicate in right column the number of each item):

Number of items

1. ☐ fee calculation sheet
2. ☐ original separate power of attorney
3. ☐ original general power of attorney
4. ☐ copy of general power of attorney; reference number, if any:
5. ☐ statement explaining lack of signature
6. ☐ priority document(s) identified in Box No. VI as item(s):
7. ☐ translation of international application into (language):
8. ☐ separate indications concerning deposited microorganism or other biological material
9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other))
 - (i) ☐ copy submitted for the purposes of international search under Rule 13ter only (and not as part of the international application)
 - (ii) ☐ (only where check-box (b)(i) or (b)(ii) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Rule 13ter
 - (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column
10. ☐ other (specify):

Figure of the drawings which should accompany the abstract:

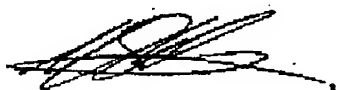
1

Language of filing of the international application: GB

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

SHELLEY, Mark Raymond



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1. Date of actual receipt of the purported international application: 29 APRIL 2002 29/04/2002	2. Drawings: <input checked="" type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid

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Date of receipt of the record copy by the International Bureau:

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AMPHIBIOUS VEHICLE

This invention relates to amphibious vehicles and in particular concerns
5 improvements relating to the stability of amphibious road vehicles on water.

The design of amphibious vehicles is often a compromise between the conflicting
design requirements of road and water vehicles. For instance, amphibious road
vehicles must satisfy certain design criteria for road use which conflict with water
10 borne stability criteria. Water borne stability can be less than optimum when vehicle
dimensions, in particular width, are determined for road use since narrow body
amphibious vehicles optimised for manoeuvrability on roads generally have unstable
narrow hulls.

15 There is a requirement for an amphibious road vehicle which is suitable for road and
water use and which is both stable on water and manoeuvrable on land particularly
on roads.

According to an aspect of the invention there is provided an amphibious vehicle
20 having at least one sponson. In the context of the present invention the term sponson
includes any flotation device positioned laterally on the hull of an amphibious vehicle.
The additional buoyancy provided by the sponson improves the stability of the
amphibious vehicle on water and allows narrow hull designs to be used for
amphibious vehicles. A narrow hull can reduce hydrodynamic drag and hence fuel
25 consumption as well as allowing higher vehicle speeds on water. Narrow hulls are

also preferable for narrow body amphibious road vehicles.

Preferably, the sponson is movable between a stowed position and a deployed position. In this way the sponson may be moved to a deployed position for use of the vehicle on water and stowed when the vehicle is operating on land.

In preferred embodiments, the sponson is movable with respect to a main hull of the said vehicle.

The sponson may be spaced at least one hull width away from the said hull when in the said deployed position. This improves stability since the buoyancy forces acting on the sponson can provide a significant turning moment on the vehicle to stabilise the vehicle by reducing the vehicle's tendency to roll in both calm and rough water conditions.

The sponson may also be substantially flush with the said hull when in said stowed position. This allows the frontal cross-section area of the vehicle to be reduced when the sponson is not required, that is when the vehicle is to be driven on the road. Not only does this provide for vehicle manoeuvrability on the road but it also reduces aerodynamic drag on the vehicle when moving on the road.

Preferably, the sponson is positioned substantially parallel with the main hull when in the said stowed and deployed positions. This reduces hydrodynamic drag when in the deployed position and allows the sponson to be readily stowed next to the hull

when not in use.

Preferably, the sponson is pivotally mounted with respect to the said main hull. This readily permits the sponson to be deployed for use.

5

In preferred embodiments, the sponson comprises part of a respective parallelogram type four-bar linkage pivotally mounting the sponson with respect to the said main hull. The four bar linkage geometry provides for easy and accurate deployment of the sponson to its deployed position and further provides a mechanically stiff and robust structure which can readily transmit buoyancy turning moments generated by the sponson to the hull of the vehicle.

10

The sponson may be pivotally mounted with respect to the main hull about pivot axes inclined with respect to the plane of the keel of the said hull such that the sponson is raised with respect to the keel when moved from its stowed to deployed position. The sponson can be moved to a preferred operational position above the keel line of the main hull when deployed and stowed in a lower non-obstructive position when not in use.

15

In preferred embodiments, the sponson moves in an aft direction with respect to the vehicle when moved from its stowed to deployed position. This provides for a more compact design.

20

The amphibious vehicle preferably comprises a sponson on each side of the vehicle.

In this way buoyancy turning moments can be applied to the vehicle in both directions. This improves the above mentioned advantages since vehicle stability is significantly improved.

- 5 In preferred embodiments, the vehicle comprises fore and aft road wheels and the sponson is stowed in the region between the said fore and aft wheels. This provides a compact design and readily allows the sponson to be deployed without interfering with the road wheels.
- 10 In preferred embodiments, the amphibious vehicle comprises road wheels which are movable between a fully deployed position for road use and a stowed position for water borne operation, whereby the ride height of the vehicle on land can be adjusted by positioning the said wheels intermediate the said fully deployed and stowed positions. By retracting the road wheels to their stowed position hydrodynamic drag
- 15 forces can be reduced.

The road wheels may be pivotally mounted with respect to the main hull of the vehicle for movement between their said respective stowed and deployed positions. This readily allows the road wheels to be moved between their respective stowed and

20 deployed positions.

Preferably, the amphibious vehicle is a passenger vehicle.

In another aspect of the invention there is provided an amphibious vehicle having a

5

transom extension member which is movable to a deployed position for increasing the effective water line length of the vehicle by at least 5%. This is capable of significantly reducing the hydrodynamic drag forces acting on the vehicle and particularly at speeds above 12 knots. This provides a more efficient hull design
5 allowing higher speeds to be reached as well as reducing fuel consumption.

In another aspect of the invention a amphibious vehicle comprises a hull having at least one propeller tunnel having a depth dimension greater than half the propeller diameter of the propeller in the said tunnel.

10

Various embodiments which more particularly describe the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded view of the main components of an amphibious road
15 vehicle;

Figure 2 is a side elevation of an amphibious vehicle comprising the components shown in Figure 1;

Figure 3 is a cross-sectional view along line I-I of Figure 2; and

Figure 4 is a plan view in the direction of arrow A in Figure 2.

20 Figure 5 is a perspective view of the aft end of the vehicle of figures 1 to 4 with a horizontally deployed transom;

Figure 6 is a perspective view of the aft end as Figure 5 with the transom in a vertical stowed position;

Figure 7 is an end view of the aft end of the vehicle of Figures 1 to 6;

Figure 8 is a cross-section view along line II-II of Figure 7; and

Figure 9 is a detailed perspective view of the flow direction flap assembly shown in Figure 8.

5 Referring to Figure 1 the main structural components of an amphibious road vehicle 10 are shown in exploded view. The main structural components include a mono-hull 12, a passenger deck 14 and a passenger cabin 16. The vehicle 10 also comprises a pair of sponsons 18, only the starboard sponson being shown in Figure 1. The mono-hull, deck, passenger cabin and sponsons are constructed using an epoxy glass
10 reinforced material and high density foam in a sandwich laminate construction. The sponsons 18 are additionally filled with a solid buoyancy material.

The main structural components are assembled to form an amphibious road vehicle of the type indicated at 20 in Figure 2. The amphibious vehicle of Figure 2 has a
15 length of approximately 12 metres a beam or width for approximately 2.5 metres, a height of approximately 4 metres and is adapted to carry 40 passengers and 2 crew members. The vehicle 20 has fore and aft road wheels 22 and 24 positioned towards the vehicle's bow 26 and stern 28 respectively. The wheels 22 and 24 are rotatably mounted on respective pivot supports 30 which are pivotally mounted about
20 respective pivot axis 32 for movement of the wheels between the deployed position shown in Figure 2 and a stowed position (not shown) above the nominal water line indicated by the chain dot line 34. The fore and aft pivots 30 are movable about their respective pivot axes 32 in the direction indicated by the respective directional arrows 36. A sponson 18 is mounted on each side of the vehicle 20 between the fore and aft

wheels 22 and 24 below the deck 14 (towards the bottom of the drawing in Figure 2).

Referring to Figure 3, the port and starboard sponsons are each pivotally connected to a respective side of the hull 12 by means of arms 38. The arms 38 are generally X-shaped having two pivotal connection points 40 at one end connecting the arm to the sponson and two further pivotal connection points 42 at the other end connecting the arm to the hull about an axis 44 inclined with respect to the plane of the hull indicated by the chain dot line 46. The sponsons 18 are each movable between their respective stowed positions, as indicated by the dashed sponson outlines 48 where they lie parallel with and adjacent to the hull 12, and their respective deployed positions as shown by the solid lines in the drawing. When deployed to the position shown in Figure 3 the sponsons are spaced at least one hull width away from the sides of the hull so that the overall width or beam of the vehicle is extended to approximately 6 metres from starboard to port sponson.

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As shown in Figure 3 the inclined nature of the pivot axes 44 causes the sponsons 18 to move in a direction away from the keel 50 of the hull when deployed so that the sponsons contribute little to the buoyancy of the vehicle other than to stabilise the vehicle on the water. The primary buoyancy of the vehicle is provided by the monohull 12. This reduces the loads supported by the arms 38 during normal operation.

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The action of raising the sponsons to the deployed position shown above the keel line has the desired affect that the sponsons act mainly as stabilisers and not secondary hulls.

Referring now to Figure 4, the sponsons 18 are each pivotally connected to a respective side of the hull 12 by two arms 38 spaced along the length of the hull. On each side of the vehicle the sponson 18 forms part of a parallelogram type four bar linkage with the arms 38 and the hull 12 so that the sponson can be readily moved
5 between the deployed position, shown where it lies parallel with and spaced apart from the hull 12, and the stowed position indicated by the respective dashed outlines 51 by movement of the arms 38 about their respective pivot axes 44 through an arc of approximately 90° as indicated by respective chain lines 52. The four bar linkage arrangement causes the sponsons 18 to move aft when they are moved from their
10 stowed position to their deployed position. Throughout the movement sequence the sponsons remain parallel with the hull 12 until they are locked in the deployed position by locking means (not shown).

The drawing of Figure 4 also shows the position of the fore and aft road wheels when
15 moved to their raised position above the water line 34. The raised or stowed position of the four road wheels 22 is indicated by the chain dot lines 22' and the stowed or raised position of the aft road wheels 24 is indicated by the chain dot lines 24'.

Referring now to Figure 5, in preferred embodiments the amphibious vehicle
20 comprises a transom extension which is moveable between a deployed and stowed position as shown in Figures 5 and 6 respectively. The transom extension comprises a generally flat rectangular panel 53 which is pivotally mounted at its forward edge 53a to a pair of vertical slide supports 55 mounted on the vertical end panel or transom 57 of the hull. The aft end 53b of the panel 53 is pivotally connected to a

pivotal support 56 in the form of a ladder type member which is pivoted at its other end to a vertical panel 16a comprising the aft end of passenger compartment 16. A pair of lateral side panels 54 are pivotally mounted along the lateral side edges of the panel 53 between the edges 53a and 53b. The side panels 54 are moveable between
5 their deployed positions shown in Figure 5 and a stowed position where they lie flat against the panel 53. In the deployed position of Figure 5 the transom extension panel 53 extends substantially horizontally and perpendicular to the hull end transom panel 57a.

10 In the stowed position of Figure 6 the panels 53 lie substantially flat against the transom panel 57 facing outwards and with the pivotal support 56 lying flat against the panel 53 and the end panel 16a.

In the embodiment of Figures 5 and 6 the transom extension panel 53 has a width of
15 approximately 1.5 metres, a length of approximately 1.5 metres and the side panels 54 have a width of approximately 0.5 metres. The transom extension extends the effective water line length of the amphibious vehicle by at least 5% reducing the hydrodynamic drag on the vehicle particularly at speeds above 12 knots. In this respect the effective water line length of the vehicle can be increased by deploying the
20 transom extension while manoeuvrability of the vehicle on land is not affected when the transom is in the stowed position as shown in Figure 6. The transom extension is moved to the stowed position by sliding the forward edge 53a along the slide supports 55 while the aft edge 53b is pivoted towards the vertical transom panel 57 along the trajectory indicated by the chain dot lines 58. The side panels 54 fold flat

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against the main panel 53 as indicated by the chain dot lines 59.

In the deployed position of Figure 5 the panel 53 lies substantially tangential to a pair of parallel and substantially semi-circular cross-section propeller duct tunnels 69 extending at least part way along the rear section of the hull 12. This can be best seen with reference to Figure 7 where the underside of the panel 53 is indicated at 71.

Referring to Figure 8, three flow direction flaps 60, 61 and 62 are pivotally mounted at their respective upstream ends to the aft end of the propeller tunnel wall sections 72. The port side flap 60 is mounted at the end of the port side tunnel wall, the starboard side flap 52 is mounted at the end of the starboard side tunnel wall and the central flap 61 is mounted at the end of the central tunnel dividing wall between the port and starboard tunnels. The flaps 60, 61 and 62 have aerofoil type cross-sections and are arranged with their trailing edges at the downstream end of the propeller tunnels. The propellers are mounted on respective drive shafts 76 upstream of the flaps 60, 61 and 62 so that the flow of water exiting the propellers can be directed by moving the flaps about their respective pivot axes.

As can best be seen with reference to Figure 9, the flaps 60, 61 and 62 are mounted at their upstream ends on respective spindles 63, 64 and 65 extending perpendicular to the aerofoil cross-sections of the flaps. The spindles 63, 64 and 65 are aligned with each other and the flaps 60, 61 and 62 are pivotally connected together by means of a pair of bar type links 66 and 67. The links 66 and 67 are connected towards the downstream end of the flaps so that rotation of the starboard flap 62 about its axis 65

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by rotation of a co-axially mounted actuator shaft 68 causes translation of the links 66 and 67 which imparts a turning moment on the flaps 60 and 61 so that all three flaps turn in unison about their respective pivot axes by equal angular amounts. The shaft 68 preferably extends through an aperture in the hull and is connected to an
5 actuator linked to or controlled by the vehicle steering system (not shown).

It is preferred that the amphibious vehicle described comprises so-called "deep propeller tunnels" in combination with the flow direction flaps 60, 61 and 62. In the context of this description a "deep propeller tunnel" has a depth dimension greater
10 than half the diameter of the propeller that is mounted within the tunnel duct. Deep tunnels allow the propellers to be protected and provide a greater hull displacement for restricted hull length, breadth and depth dimensions. As shown in Figure 8 the flow direction flaps are fitted aft of the propellers for directing the thrust from the propeller to port or starboard to manoeuvre the vehicle in the water. The flow
15 direction flaps in the embodiment described are arranged so that on deflecting the flow from the propellers the minimum amount of flow restriction is induced thereby maintaining speed during manoeuvring, reducing the turning circle and allowing the vehicle to be turned within its own length when on water.

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CLAIMS

1. An amphibious vehicle having at least one sponson.
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2. An amphibious vehicle as claimed in Claim 1 wherein the said at least one sponson is movable between a stowed position and a deployed position.
3. An amphibious vehicle as claimed in Claim 2 wherein said at least one
10 sponson is movable with respect to a main hull of the said vehicle.
4. An amphibious vehicle as claimed in Claim 3 wherein the said at least sponson is spaced at least one hull width away from the said hull when in said deployed position.
15
5. An amphibious vehicle as claimed in Claim 3 or Claim 4 wherein the said at least one sponson is substantially flush with the said hull when in said stowed position.
- 20 6. An amphibious vehicle as claimed in any one of Claim 3 to 5 wherein the said at least one sponson is positioned substantially parallel with the said main hull when in the said stowed and deployed positions.
7. An amphibious vehicle as claimed in any one of Claims 3 to 6 wherein the
25 said at least one sponson is mounted with respect the said main hull by a linkage of

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pivoted arms.

8. An amphibious vehicle as claimed in Claim 7 wherein the said at least one sponson comprises part of a parallelogram linkage pivotally mounting the sponson with respect to the said main hull.

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9. An amphibious vehicle as claimed in Claim 7 or Claim 8 wherein the said at least one sponson is pivotally mounted with respect to the main hull about pivot axes inclined with respect to the plane of the keel of the said hull such that the sponson is raised with respect to the keel when moved from its stowed to deployed position.

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10. An amphibious vehicle as claimed in any one of Claims 7 to 9 wherein the said at least one sponson moves in an aft direction with respect to the vehicle when moved from its stowed to deployed position.

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11. An amphibious vehicle as claimed in any preceding claim comprising a sponson on each side of the vehicle.

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12. An amphibious vehicle as claimed in any preceding claim wherein said vehicle comprises fore and aft road wheels and said at least one sponson is stowed in the region between the said fore and aft wheels.

13. An amphibious vehicle as claimed in any preceding claim wherein the vehicle comprises road wheels which are movable between a fully deployed position for road use and a stowed position for water borne operation, whereby the ride height of the

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vehicle on land can be adjusted by positioning the said wheels intermediate the said fully deployed and stowed positions.

14. An amphibious vehicle according to Claim 13 wherein the said road wheels
5 are pivotally mounted with respect to the main hull of the vehicle for movement between their said respective stowed and deployed positions.

15. An amphibious vehicle as claimed in any preceding claim wherein said vehicle is a passenger vehicle.

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16. An amphibious vehicle as claimed in any preceding claim wherein the vehicle comprises a transom extension member for increasing the effective water line length of the vehicle by at least 5%.

- 15 17. An amphibious vehicle as claimed in Claim 16 wherein the transom extension member is movable between a deployed position substantially parallel with the water line of the said vehicle and a stowed position.

18. An amphibious vehicle as claimed in Claim 17 wherein the transom extension
20 stows substantially flat against the aft end of the vehicle.

19. An amphibious vehicle as claimed in any preceding claim wherein the hull comprises at least one propeller tunnel.

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20. An amphibious vehicle as claimed in Claim 19 wherein the vehicle comprises a pair of propeller tunnels.

21. An amphibious vehicle as claimed in Claim 19 or Claim 20 wherein the or
5 each propeller tunnel has a depth dimension greater than half the diameter of the propeller with the respective tunnel.

23. An amphibious vehicle as claimed in Claim 19 or 20 wherein the tunnels
comprise at least two flow direction flaps pivotally mounted towards a downstream
10 end thereof for directing output flow from the propeller in a determined direction.

24. An amphibious vehicle substantially as hereinbefore described with reference to the accompanying drawings.

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ABSTRACT

AMPHIBIOUS VEHICLE

An amphibious vehicle 20 for land and water use comprises a main mono hull section 12 and a pair of port and starboard sponsons 18 which are movable from a stowed position under a main vehicle deck adjacent to the mono hull 12 and a fully deployed position in which the sponsons are spaced apart from the mono hull by at least one hull width. The sponsons are each pivotally connected to the main hull by means of a pair of respective arms 38 which together with the sponson and the hull define a parallel type four bar linkage. The sponsons stabilise the vehicle on water and are readily stowed to allow vehicle mobility on land.

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(Figure 3)

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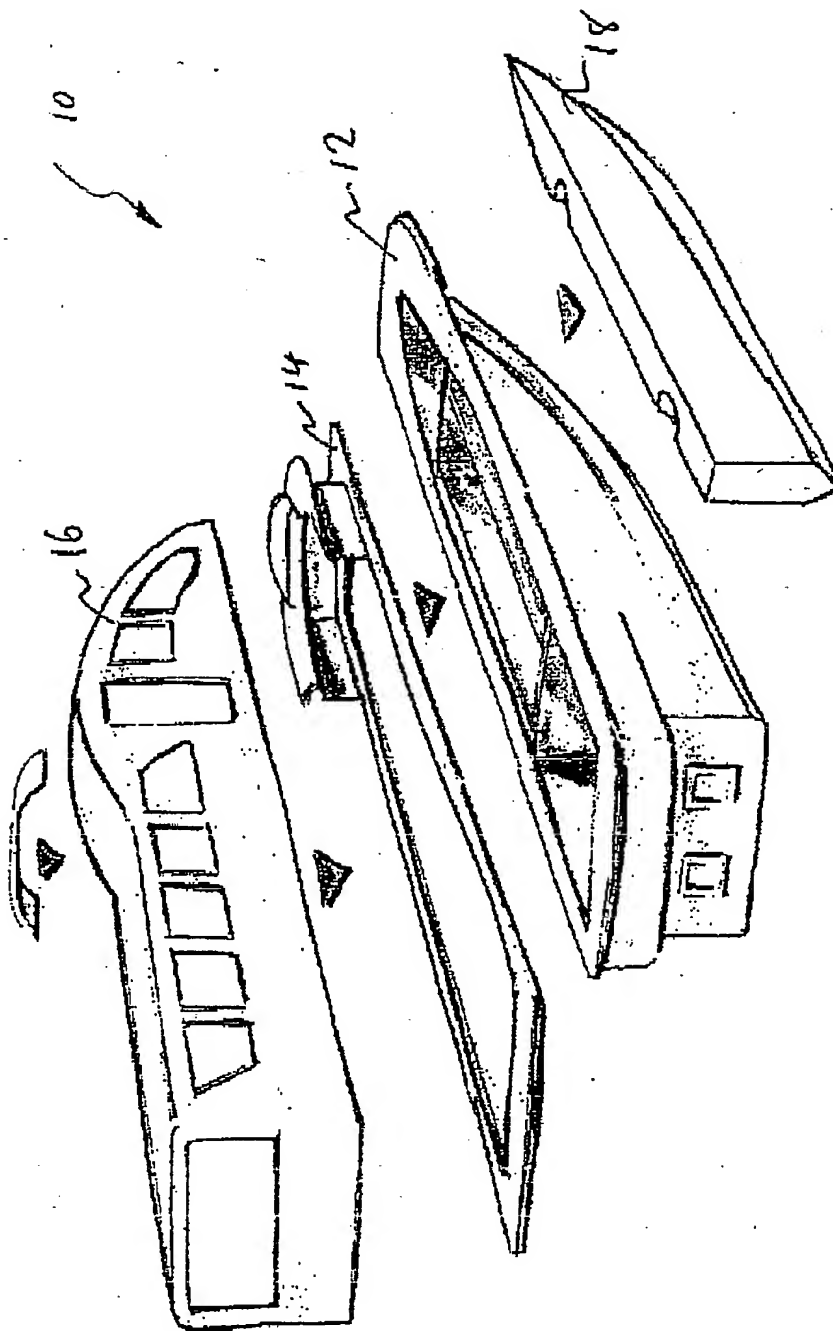
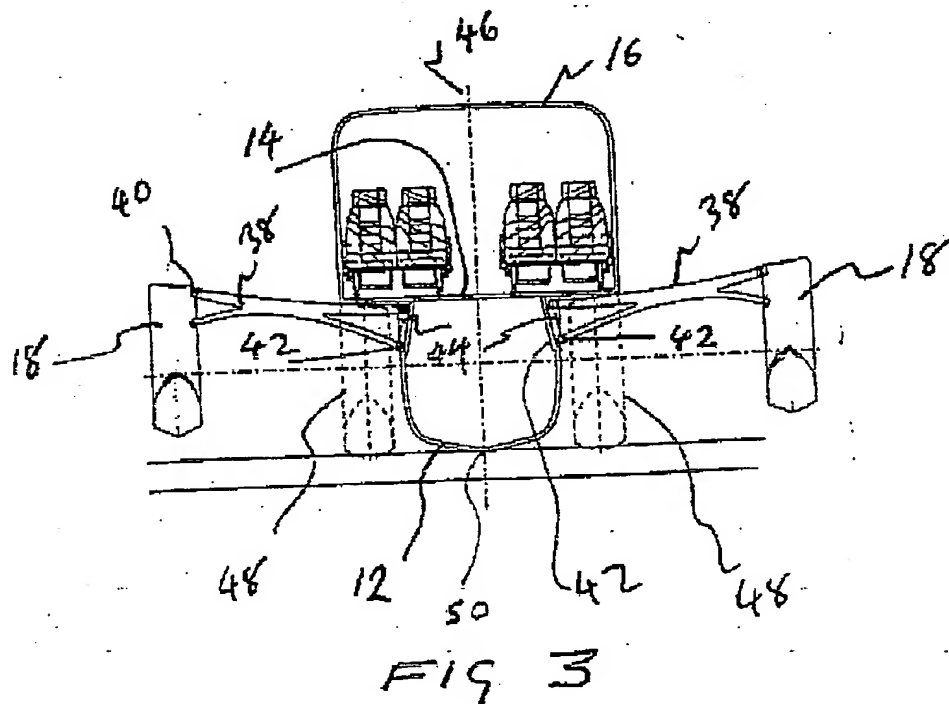
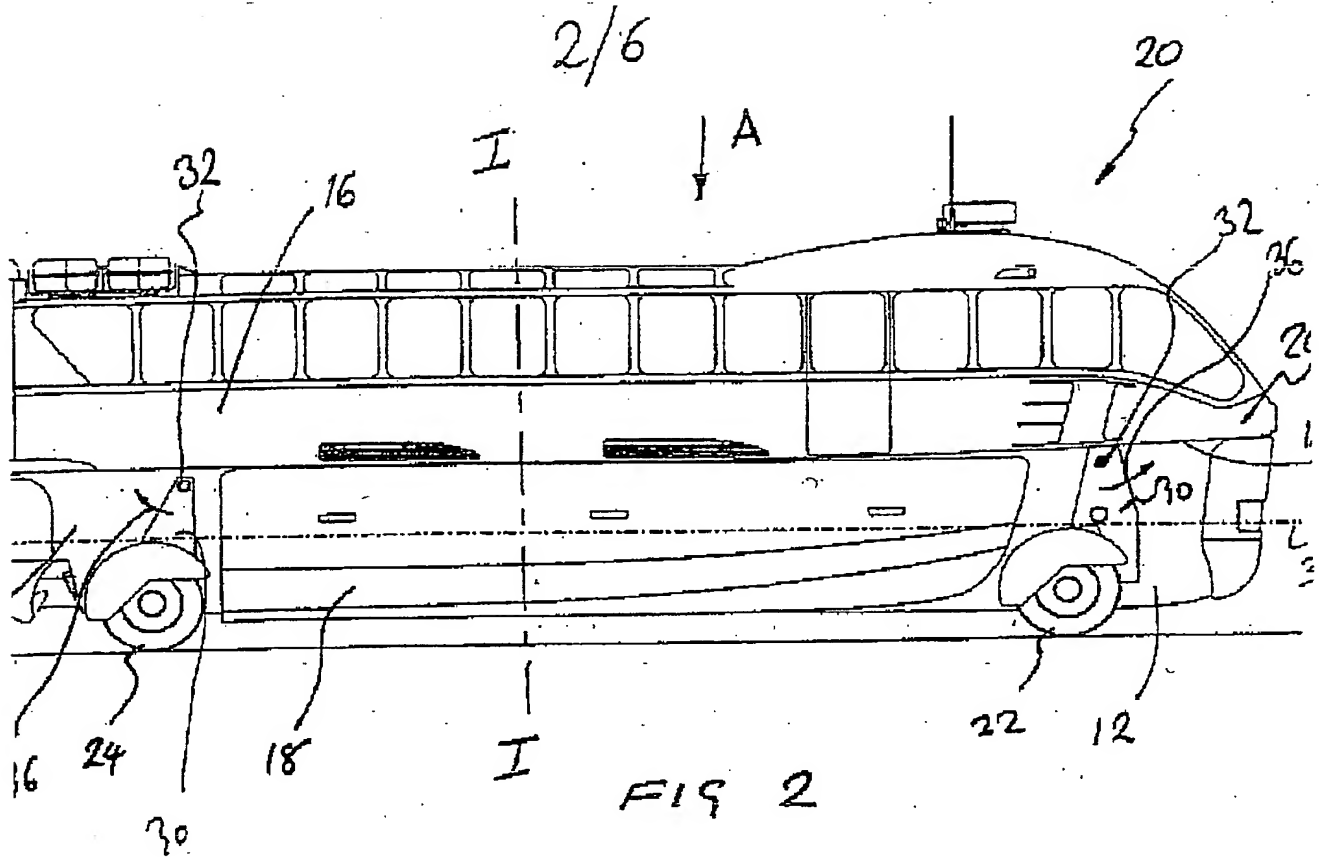


FIG. 1

[F] ASSEMBLY

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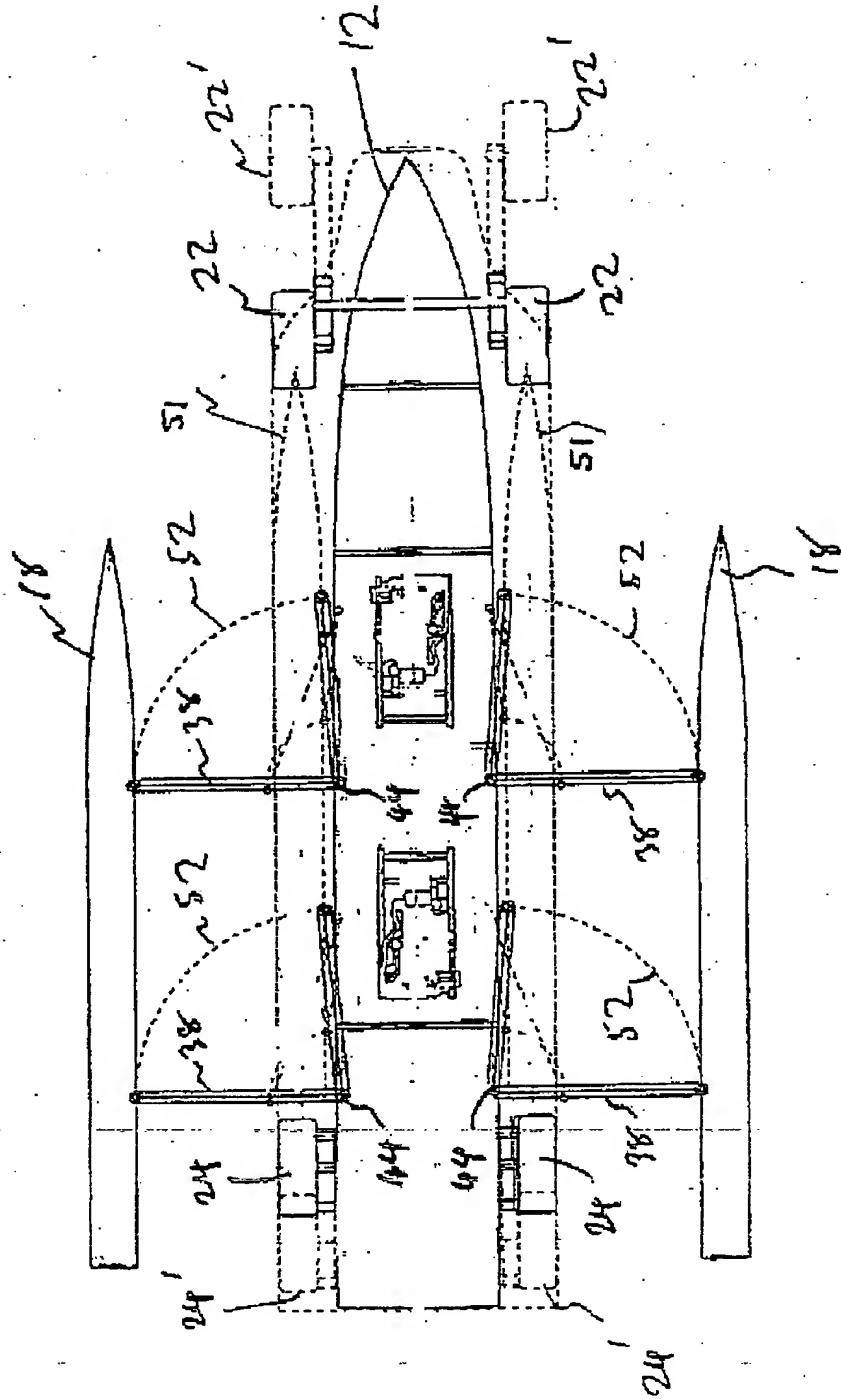


Fig 4

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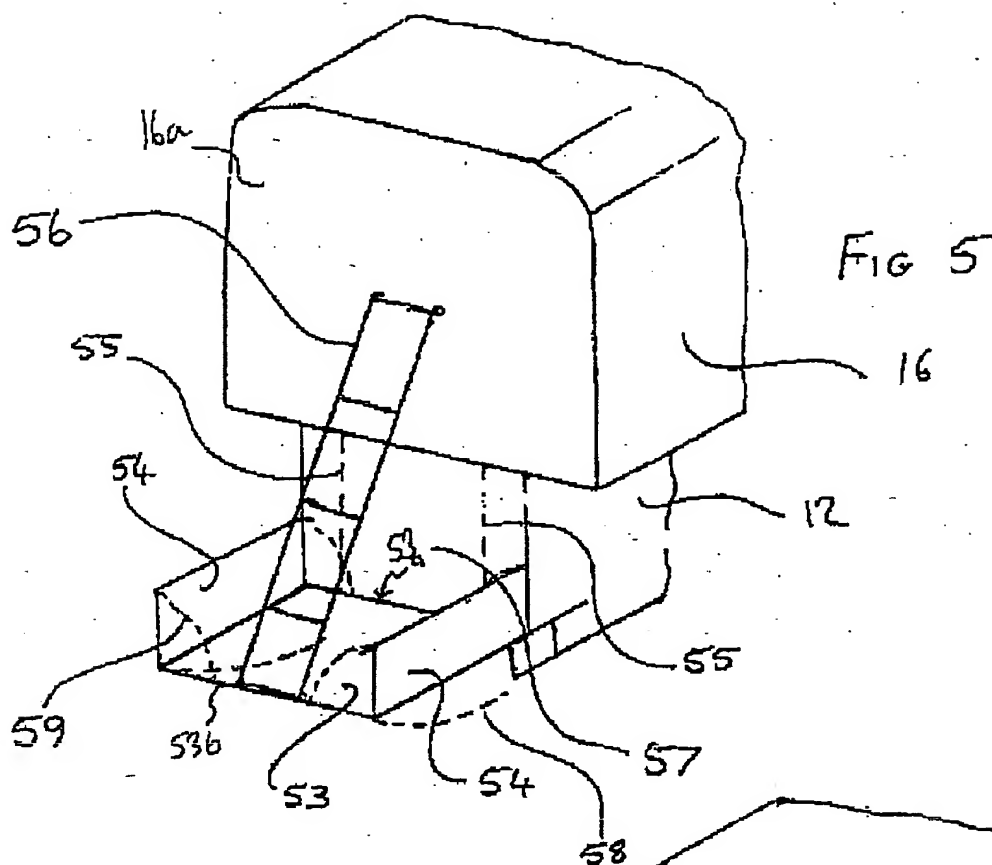
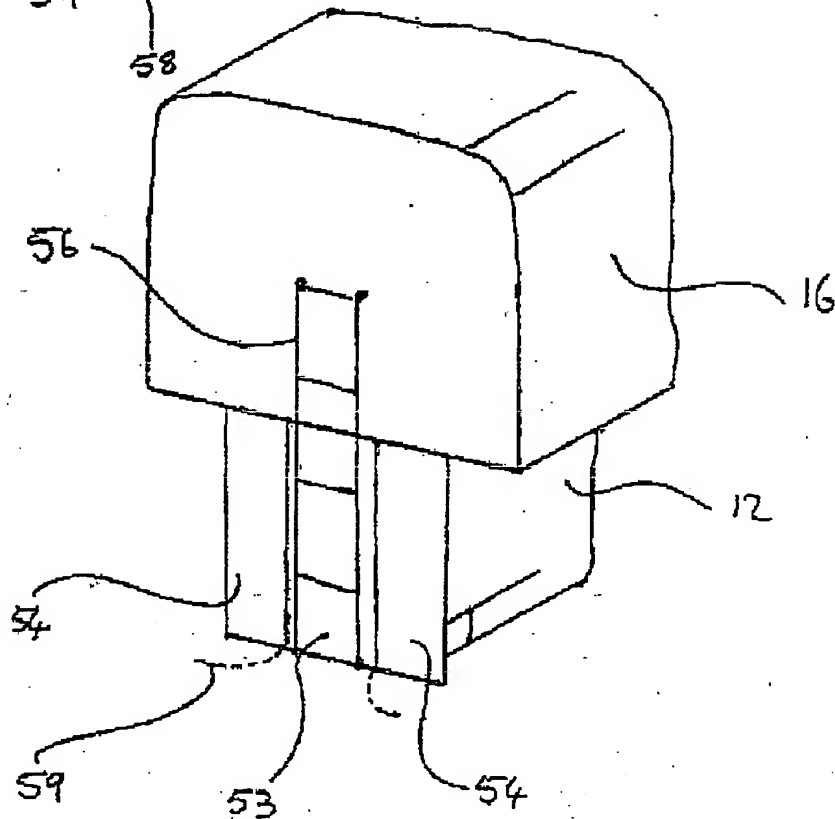


Fig 6



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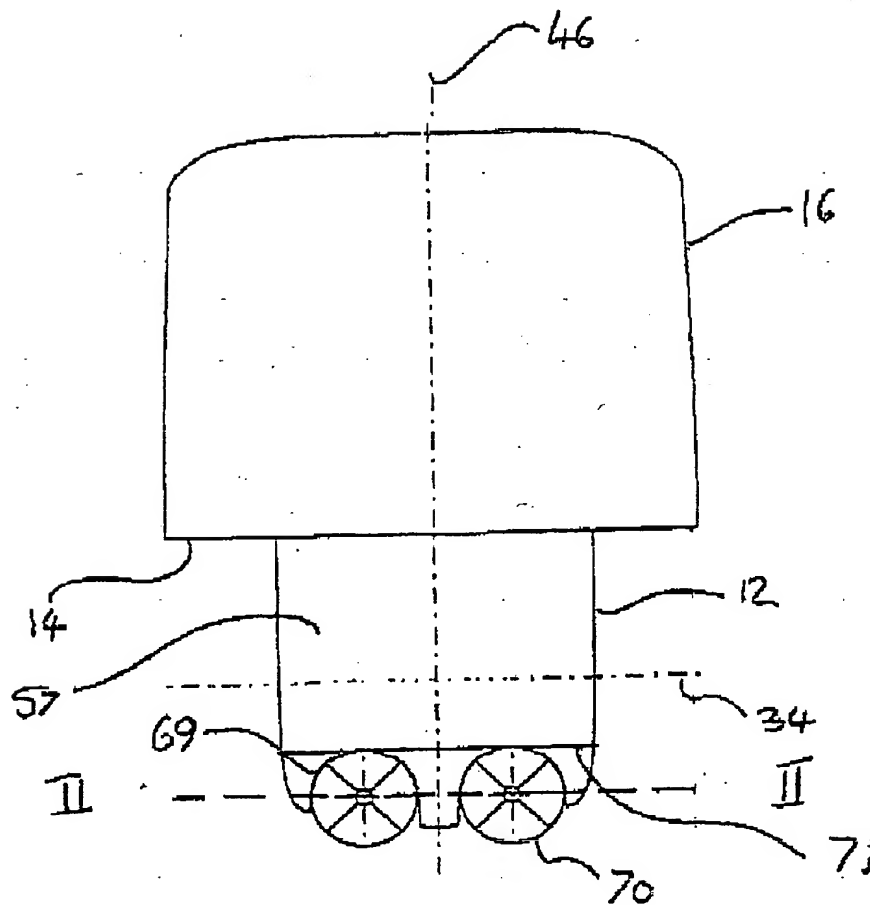


FIG 7

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FIG 9

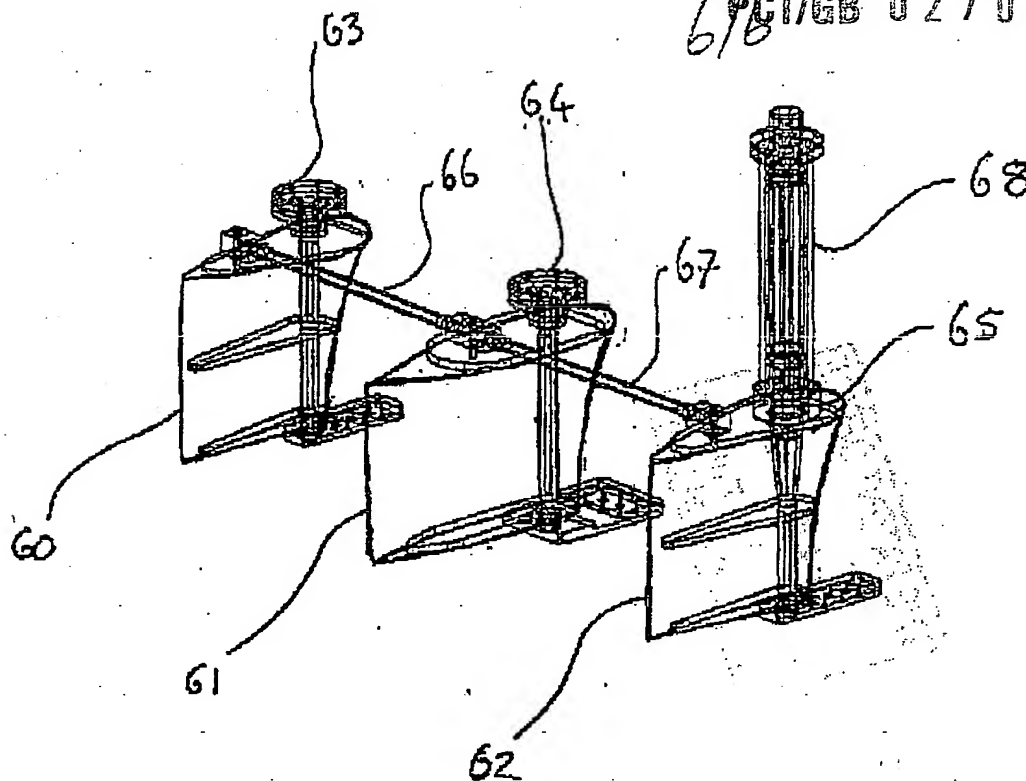
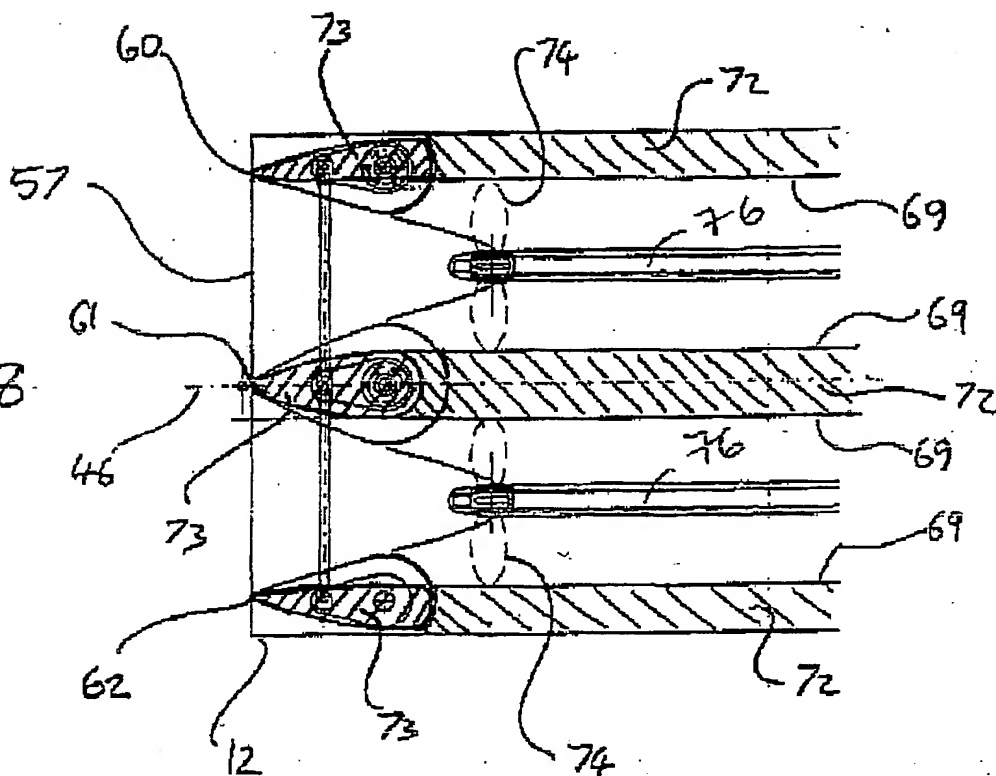


FIG 8



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